No. 785,066. PATENTED MAR. 14, 1905.

E. S. FARWELL.

NOZZLE FOR TURBINE ENGINES.

APPLICATION FILED DEC. 16, 1903.

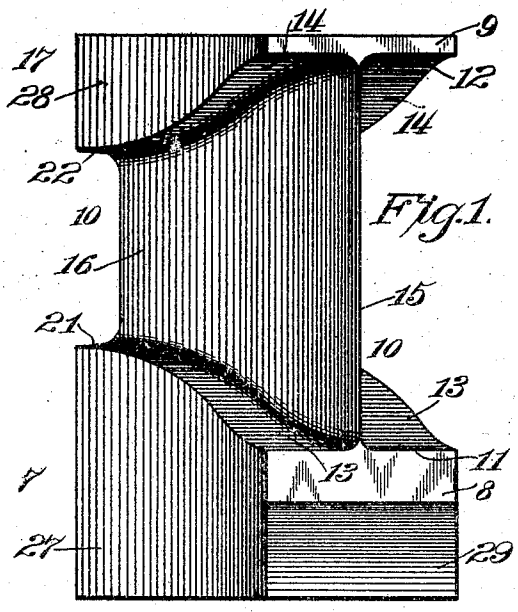


Fig. 1.

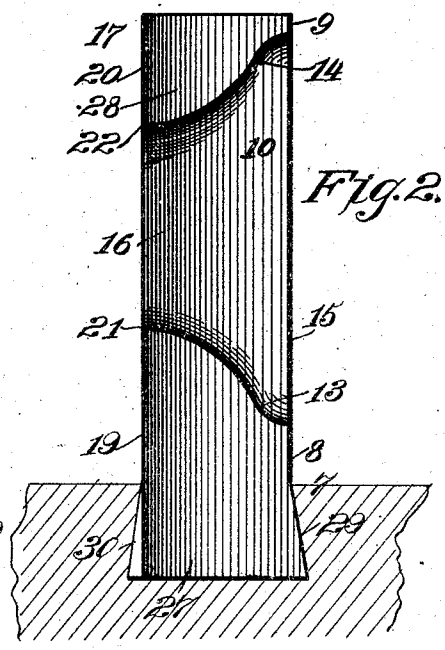


Fig. 2.

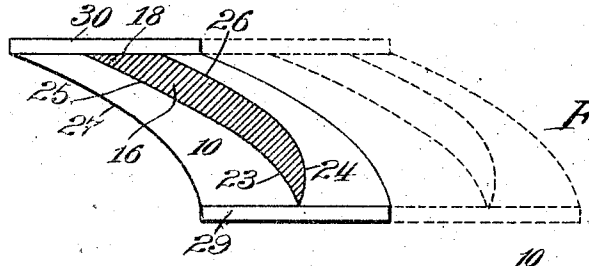


Fig. 3.

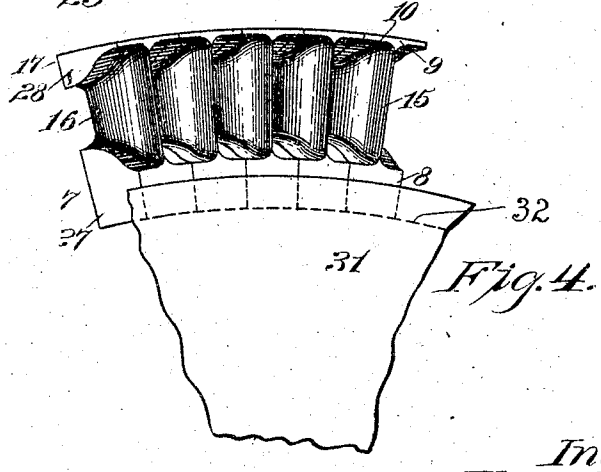


Fig. 4.

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No. 785,066. Patented March 14, 1905.

UNITED STATES PATENT OFFICE.

ELMER S. FARWELL, OF RIDGEWOOD, NEW JERSEY, ASSIGNOR TO EDWIN H. LUDEMAN, OF BROOKLYN, NEW YORK.

NOZZLE FOR TURBINE-ENGINES.

SPECIFICATION forming part of Letters Patent No. 785,066, dated March 14, 1905.

Application filed December 16, 1903. Serial No. 185,351.

To all whom it may concern:

Be it known that I, ELMER S. FARWELL, a citizen of the United States, residing in Ridgewood, in the county of Bergen and State of New Jersey, have invented certain new and useful Improvements in Nozzles for Turbine-Engines, of which the following is a specification.

This invention relates to and has for an object to provide an improved jet-nozzle for turbine-engines and for the elements or units constituting the same.

The nozzles in a turbine-engine require for efficient service to be of peculiar formation and which if made directly in the casing require considerable manipulation in producing the same in smooth and proper shape, and if the same are made in a separate ring they will require to be operated upon by machinery, it being difficult to form a nozzle-ring or a casing with a series of nozzles in one piece and have the nozzle-apertures produced at the time of the formation thereof. By the present unital construction, however, it is possible to cast or forge a number of elements or units which upon being assembled will form a series of nozzles, which series may be in the form of a ring, if the construction of the engine in which it is employed requires the nozzles to be in a ring. Each unit may be formed by itself and the units readily assembled, and if one unit or a portion of a series becomes worn out or defective it is possible to replace the same without destroying the entire set of nozzles, and also, the elements being small, a defect in one part may be remedied in assembling by merely taking a perfect element in its place, which could not be done if the entire complement of nozzles were made in one piece. The nozzle elements or units may also be so formed that they may readily interlock with some portion of the engine, which may be appropriately-formed grooves or channels in the frame of the engine, whereby they may be readily and rapidly assembled and locked in their assembled position, one nozzle holding the previous one in position as it is brought to position. Such means of securement may embody an undercut channel or groove and a dovetailed or flaring end upon the base of the unit, which form of fastening is shown in connection with vanes or buckets for turbine-engines embodied in my application for United States Letters Patent, filed on the 4th day of December, 1903, and bearing Serial No. 183,687.

In the drawings accompanying and forming a part of this specification an illustration of my invention is shown, wherein—

Figure 1 shows in front elevation a form of nozzle unit. Fig. 2 is a side view thereof from the left-hand side of Fig. 1. Fig. 3 is a cross-section through the web portion of Fig. 1 looking downwardly, and Fig. 4 is a detail showing a manner of assembling the units.

Before particularly pointing out the novel and peculiar features of these units a further description of the drawings as such will be given. Fig. 1 shows a unit as viewed from the portion which is seen in the lower part of Fig. 3. The plan shown in dotted lines at the right hand of Fig. 3 indicates the position which will be occupied by another and similar unit in building up the nozzle series. The full-line portion of Fig. 3 is a plan from which Fig. 1 is projected.

In the form of the invention herein illustrated there is shown a base portion (designated in a general way by 7) which has a face or wall 8 and a face or wall 9 upon the head portion. Such faces are shown herein substantially transverse to the mouth of the jet-opening, (designated in a general way by 10.) Each of the elements or units is shown as having in it chambers comprising halves of two nozzles. The nozzle-chamber is shown substantially hopper-shaped, the mouth portion of which is comparatively wide, it being surrounded at the commencement thereof by the junctures 11 and 12 of the faces 8 and 9 with the walls 13 and 14, which latter walls or faces in the illustration shown embody the bottom and top, respectively, of the nozzle or nozzle-chambers—that is, if the nozzle with the surrounding parts are assumed to be in the relative position that they occupy when laid out on the drawings herein the expressions of di-

rection are arbitrarily used in connection with the showing herein, as it will be apparent that in practice the units will occupy various positions, frequently being arranged in a circle, which will place units at various angles to other units. The other surrounding walls of the nozzle-chamber at the entrance of the same comprise the edges 15 of a web portion, bearing in the drawings the character of reference 16, which unite the head portions (designated in a general way by 17) with the base portions. The web at the discharge end presents a face 18 of considerable width, which face or wall is substantially parallel with faces 19 and 20, which are transverse to such discharge end of the nozzle. It will be seen that the webs at the receiving end are brought down to a comparatively thin edge and that at their discharge ends they are comparatively broad, thus reducing the area of the chamber materially from the mouth to the discharge end. It will also be seen that the distance between the edges 11 and 12 is comparatively greater than between the edges 21 and 22, which are the junctures between the merging of the faces 13 and 14 with the faces 19 and 20, respectively. Thus in the present instance the nozzle is reduced in area in both directions, so that the velocity of steam in its passage therethrough will be increased. The web is shown as having a curve from one end to the other, presenting a concave wall or face 23 adjacent to the edge and a convex wall or face 24 upon the opposite side thereof. Such faces are herein shown at substantially similar angles to faces 8 and 9. From the said concave and convex faces, respectively, there are shown comparatively plane faces 25 and 26, continuing to the discharge end of the chamber. Steam impinging upon the edge 15 will be curved and discharged from the nozzle at a considerable angle to its direction of entry, whereby the steam will be directed upon the vanes or buckets in a manner to give the greatest force for a given amount of expansive fluid. The side walls or faces 27 and 28 of the body and head portions of the nozzle units are also in the present instance shown curved, similar curves being illustrated upon both sides, whereby one unit may be assembled closely to another similar unit and make a comparatively steam-tight joint. The sides may be made plane instead of curved, or they may be given some other convenient face formation.

For the purpose of assembling the units in an engine or structure where the same are to be employed an undercut groove or channel may be made and the base portion be provided with flaring or dovetailed faces 29 and 30 to take under the wall of such channel. Owing to the peculiar formation of the body portion and the head portion whereby the faces 19 and 30 and the faces 8 and 29 are not directly opposite each other; it will be possible to place the body into the undercut channel and turn the same into position in a channel which is no wider at any portion than the corresponding width of the unit. By this means the channel may be filled up with the units and the last unit of the series secured in some convenient manner, a convenient manner of so doing being described in my above-mentioned application for United States Letters Patent, although other means may be employed, if found desirable.

It will be apparent, of course, that the faces of the head and body upon the respective sides of each unit are to be at an angle if they are to be used in a ring, so that in forging, casting, or subsequently machining, as the case may be, the angle of such faces to the general body of the device will be determined by the diameter of the contemplated completed circle.

In the foregoing description the terms "ring" and "circle" have been made use of, because frequently in construction the buckets, which are to be actuated by the steam, are arranged in corresponding circles; but of course it will be apparent that any other arrangement may be made which the exigencies of the particular employment may demand.

In Fig. 4 a segment of a casing 31 is shown having a chamber 32, in which a number of units are assembled.

At times in practice it may be found desirable instead of making the faces upon angles to correspond to the radial lines at their points of location to employ some suitable elastic or compressible packing, as the case may be, between the units.

It will be apparent that in many instances a set of nozzles made up of units may only be intended to deliver fluid at certain intervals along its entire length or area, in which instance certain of the units may be made up solid or blank, and for nicer organization with such blanks some of the units may each have but half a nozzle within it, the blank half being adapted to mate with a blank and the chambered half to mate with a chamber upon a similarly-formed unit. In some form of engines it may be found desirable to vary the relative areas of the various portions of the nozzle even to the extent of having the receiving end smaller than the delivery end or to have both ends of similar area, the above description, stating which was the delivery end and which the receiving end, being merely for the purpose of illustration and not to arbitrarily restrict the use of the invention.

Many other changes of course may be made as experience requires and to suit the particular employments.

Steam is mentioned in the above description; but my invention is equally useful for other fluids, as is apparent.

Having described my invention, I claim—

1. An element for turbine-engine nozzles comprising a body portion having chambers

for the passage of fluid and a base portion having end faces provided with flaring locking-faces.

2. An element for a turbine-engine nozzle comprising two ends and a web portion joining the same and forming thereby a chamber for the passage of fluid on each side of said web portion.

3. An element for a turbine-engine nozzle comprising two ends and a web portion joining same and forming thereby two chambers for the passage of fluid, the cross-sectional area of such chambers being smaller toward the delivery end.

4. A nozzle unit having plane ends and curved sides, the curvature whereof is similar, and chambers through such sides, the walls whereof are curved at the top and bottom and converge toward the delivery end and the side walls whereof are curved and converge toward the delivery end, and one of which walls has a concave curvature adjacent to the mouth.

5. A nozzle for a turbine-engine comprising a pair of units fitting one against the other at their ends and each embodying half a hopper-shaped chamber forming together a converging passage for the motive fluid.

6. A nozzle for a turbine-engine comprising a pair of units fitting one against the other at their ends and each embodying half a chamber forming together a converging passage for the motive fluid, the base portion of said units provided with oppositely-flaring locking-faces.

7. A jet-nozzle for a turbine-engine consisting of a number of units, means for securing the units and comprising an undercut channel, dovetailed ends upon the units to interlock with such channel, nozzle-chambers through the sides of the unit, and means within the chamber to direct the course of the steam.

8. A series of jet-nozzles for a turbine-engine comprising a number of dovetailed jet-nozzle units carried by an undercut channel.

Signed at Nos. 9 to 15 Murray street, New York, N. Y., this 12th day of December, 1903.

ELMER S. FARWELL.

Witnesses:

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FRED. J. DOLE.